SERVICE MANUAL FOR THE ITI AIR BRAKE SYSTEM

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AIR BRAKE SYSTEMS

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ITI BRAKE SYSTEM OVERVIEW

The ITI brake chamber is an air actuated mechanically held parking, emergency, and service chamber for use on air braked vehicles. The brake chamber has a heavy duty rubber diaphragm which moves against a metal push plate and rod assembly under the influence of air pressure. The push rod which has machined grooves or "teeth" is locked mechanically in place with a piston and pawl arrangement when air pressure is lost or exhausted from the piston chamber. The chamber itself is part of the vehicle's overall air brake system.

System design ensures that the air brake chamber functions properly. The chamber itself is very simple, resembling a service chamber whose push rod can be locked mechanically (see Figure 1). The piston itself is powered by a controlling spring which will force the locking piston into the push rod in the absence of air pressure against the piston cylinder. There are many different vehicle applications and authorized configurations for ITI systems. Additional discussion has been included in the ITI Control Valve and the Systems sections, but a generalized version is described in the following paragraphs.

SERVICE APPLICATION

The ITI chamber performs service applications in the conventional manner. Regulated air is applied to the chamber diaphragm through the normal channels to make a brake application. Usually, this is accomplished through the use of a treadle valve signalling a service relay valve.

EMERGENCY APPLICATION

ITI systems contain air valving which sense a loss of air pressure. The ITI Control Valve (CV) should be used and its operation is covered in detail within its own section. Other valves which can be used if installed within the proper system configuration are relay emergency valves, or inversion valves. All of these valves will automatically send an emergency air application to the brake chamber applying the brakes in the event of a system loss of air pressure. The mechanical piston is spring loaded and held released by primary and\or emergency tank air. If an emergency application is made due to a loss of this air pressure, the push rod will be locked in place by the mechanical piston.

PARK APPLICATION

A park application is initiated by activating the park brake control or "push-pull" valve. This will exhaust supply air to the sensing valve in the ITI system and cause the brakes to automatically apply. For those systems which use the ITI Control Valve (CV), air will then be exhausted off the piston chamber which will cause the piston to engage the teeth in the push rod locking the application in place. The locking of the push rod should occur after the brake application is made thereby eliminating a cause of wear on the push rod rack and piston tooth. If a ratcheting sound occurs on a park application this indicates an incorrect installation or malfunction and should be investigated.

Some FMVSS121 exempt systems employ a delayed mechanical park sequence. These systems contain a relay emergency valve in conjunction with an inversion load valve. In this configuration the relay emergency valve initiates automatic application if supply (or trailer emergency) air is exhausted. The piston chambers are plumbed off the emergency reservoir and will not engage unless emergency air pressure is lowered. A vehicle is therefore parked on air until or unless this tank loses air. ITI does however, recommend the use of its CV and local regulations may require its use.

MOUNTING OF THE CHAMBERS

As part of the brake system, ITI chambers must be both connected to the slack adjusters and mounted on the vehicle. Mounting brackets are provided as part of the vehicle and typically require the chambers to be aligned in either a vertical or horizontal direction. A horizontal alignment being defined as when the plane of the two mounting bolts is parallel with the ground and a vertical alignment defined as when the plane of the mounting bolts is perpendicular with the ground. Either orientation is satisfactory with the provision that if mounting the chambers horizontally they should be upright (the piston cover caps are up). Chamber orientation can be any intermediate angle between

horizontal and vertical with the same caution that the brakes should not be mounted cover cap down.

Another major consideration is that the push rod needs to be properly aligned so as to move freely in and out of the housing. This consideration is universal for all parking brake chambers. Figure 2 shows a brake mounted such that the center line of the push rod makes a 90 degree angle with the center line of the slack adjuster at a brake stroke of 1 1/2". The length of the push rod is a factor in determining this angle and it is covered in the next section. A unique consideration for the ITI is that unlike a brake chamber which has a round push rod, the ITI with its square push rod section does not rotate. Therefore it is important that the rear face of the ITI and the center line of the push rod form a 90 degree angle in both a horizontal and vertical axis at a typical calibration stroke of 1 1/2". This will ensure that the push rod will not rub against the edges of the chamber housing as it moves in and out with each brake application. If this is not evident, check mounting bracket configuration. This will enable movement of the center line of the push rod closer to the mounting hole of the slack adjuster so as to approximate the required perpendicular orientation. A check for proper alignment can be made. Loosen the slack adjuster so that the push rod of the brake can be manually pulled out of the chamber housing. Upon release of the push rod it should smoothly retract into the housing under the pressure of the return spring. There should be no binding or hanging up of the push rod in any intermediate postion.

WARNING: WHEN TIGHTENING THE JAM NUT BE SURE NOT TO TWIST THE ITI SQUARE PUSH ROD. THIS IS ACCOMPLISHED BY APPLYING THE PARKING BRAKE BEFORE TIGHTENING THE JAM NUT.

BRAKE ADJUSTMENT AND PUSH ROD LENGTH

The ITI functions as a typical brake chamber and normal brake adjustment procedures can be followed for drum and disc types. This includes charging the system with air prior to the adjustment of the brakes after initial installation. Proper push rod length is imperative. OEM manufacturers should have installed the chambers with correct push rod length. This can be verified by ensuring that with a brake stroke of 1.5" the push rod and slack adjuster should make an angle of approximately 90 degrees. See Figure 2. (The rule of thumb is to measure brake push rod to slack adjuster angle at 75% of maximum allowed push rod travel, which is 2" for most type 30 brakes.) Users should be aware that ITI brakes are shipped in the unapplied position. ITI brakes are shipped for retrofit with push rods that normally must be cut for proper installation. Different length push rod can be ordered from ITI. When determining the correct push rod length refer to the axle manufactures specifications.

INSTALLATION OF THE P/S BRAKE

The ITI brake system can be used with either single or split air systems. A split air system being defined as one having both a primary and secondary air system. For trucks, buses, and tractors these air systems are separated by one-way check valves. On trailers separate emergency and service tanks are installed with one tank being protected from loss of air pressure from the other tank. When used on a dual air system, the ITI chamber must be capable of receiving air from both primary and secondary air systems. This is accomplished through the use of the P/S housing. The ports on the P/S brake are interchangeable therefore either side of the P/S housing can be used for either delivery line, provided that one line is taken from the park and service side of the system for each brake.

With regard to suspension clearance, OEM manufacturers should have provided mechanical stops to protect the brake if required. Wishbone suspensions with close spreads from 49" to 52" should be equipped with suspension stops to prevent chamber damage.

INSTALLATION OF THE LOCK PORT LINES

The mechanical piston located in the piston cavity near the rear of the brake chamber (part #9 Figure 3) provides the mechanical lock in the case of an emergency or park application. As such it is important that it receives air from the CV (or in some cases the emergency reservoir). Either port located on both sides of the piston cavity can be used to attach this line. The two ports share a common passage so that it is possible to use the brake itself as part of the piston air pressure path. In other words, since

both brakes on an axle must receive air from the lockport on the CV, a line can be attached from the valve to one brake's piston port. A second line can then be run from the second piston port on the first brake to the closest piston port on the other brake. The second brake's remaining piston port can then be plugged. Another method of attaching these lines is to use a Male Run Tee and "T" off the first brake's piston port to the second brake on an axle. Be sure that any unused piston ports are plugged.

TOWING VEHICLE

Refer to the manual release of the parking brake.

NOTE: ALWAYS DRAIN ALL AIR BEFORE TOWING.

CAGING-MANUAL RELEASE OF THE PARKING BRAKE

One of the many advantages of the ITI brake is the easy disengagement of its mechanical lock and without the need of special tools. Tightening down on the center nut (part #5, Figure 3) of the piston assembly (part #9, Figure 3) manually pulls the piston off the push rod rack. This will release the push rod and the brake chamber will now function as a simple service brake chamber.

Steps:

1. Remove cover cap.

2. Tighten piston hex nut (clockwise) approximately 5 turns until push rod releases. **Do not overtighten or use impact tools**.

WARNING:ENSURE THE CAGING NUT HAS BEEN RETURNED TO A POSITION FLUSH WITH THE TOP OF THE PISTON BOLT BEFORE RESUMING NORMAL OPERATION OF THE BRAKE. OPERATING THE BRAKE WITH THE CAGING NUT IN ANY OTHER POSITION DISABLES THE MECHANICAL LOCKING FEATURE OF THE BRAKE.

NOTE: TO ACHIEVE BRAKE RELEASE IF USING A SYSTEM WITH THE ITI CONTROL VALVE DRAIN ALL TANKS. IT MAY ALSO BE NECESSARY TO REMOVE THE CENTER PLUG IN THE BRAKE TO RELEASE ANY AIR THAT MAY BE TRAPPED IN THE SYSTEM.

PREVENTIVE MAINTENANCE

Another of the advantages of the ITI brake is the ease and safety of working with and maintaining the brake chamber. Unlike alternative systems such as a spring brake, the emergency section of the ITI can be serviced and inspected for proper operation. Like any mechanical system, however, the ITI brake system must be maintained and serviced at periodic intervals for optimum operation.

CAUTION: BEFORE PERFORMING ANY PREVENTIVE MAINTENANCE THE VEHICLE SHOULD BE CHOCKED AND THE AIR SYSTEM DRAINED. COMPRESSED AIR IN ANY SITUATION CAN BE POTENTIALLY HAZARDOUS.

Routine Brake Inspection Interval (suggested every month, 300 operating hours, or after 15,000 miles

1. Check push rod alignment and travel.

2. Check all air hoses and mounting nuts and bolts for proper tightness.

3. Check for proper operation for the brake.

4. Park vehicle. Check for audible air leaks.

5. Perform procedure under SYSTEM CHECK.

PISTON LUBRICATION

At least once every 6 months the piston assembly should be checked for proper lubrication and

function. Adhere to the following procedure.
1. Engage the parking brake and chock the wheels so that the vehicle does not move.

2. Drain air from the system tanks.

3. Remove the piston assembly cover cap. Some models have a cap attached by a 1/4 20 screw (3/8" socket) , others have a cap which threads into the housing.

WARNING: AFTER STEP (4) IS COMPLETED THE MECHANICAL LOCK ENGAGING THE PUSH ROD WILL BE UNLOCKED AND THERE WILL BE NO PARKING BRAKE FORCE APPLIED TO THE VEHICLE FROM THIS CHAMBER. CHOCK THE VEHICLE NOW IF IT HAS NOT BEEN DONE PRIOR TO THIS STEP.

4. Cage the brake by tightening the caging bolt on the piston assembly. The caging bolt is part number #5 located on Figure 3. Approximately 4 1/2 to 5 turns should be necessary. Do not overtighten.

5. Remove the piston snap ring (part #4 on Figure 3) by using the proper snap ring pliers.

6. Lift the piston assembly (part #9) from the brake piston cylinder housing by gripping the caging nut (#5) with a pair of pliers and pulling it straight out. Do not crush caging bolt threads.

7. Wipe old lubricant from the piston assembly (#9) and from the piston cavity (brake piston cylinder housing). Check the cylinder walls for dirt and possible corrosion. Remove surface contaminants using a Silicon Carbide hone.

PISTON MAINTENANCE KIT (PART NO. 04-02-3350) IS AVAILABLE FROM ITI AND THEIR USE IS STRONGLY RECOMMENDED. CONTAINED WITHIN THE KIT ARE O-RINGS, SILICONE LUBRICANT, SILICON CARBIDE HONE, AND THE OTHER MATERIALS NECESSARY TO SUCCESSFULLY SERVICE THE BRAKE. A MAINTENANCE KIT CAN SUPPORT MANY INDIVIDUAL BRAKE PREVENTATIVE MAINTENANCE CYCLES AND ADDITIONAL SILICONE CAN BE ORDERED DIRECTLY FROM ITI OR ITS REPRESENTATIVE IF NEEDED.

8. The carbide hone should be used with a low RPM drill (500-800 RPM) and first soaked with a light weight oil or penetrating oil. The hone should be moved in and out of the piston chamber bore 4 to 5 times. Wipe clean and inspect the bore. Repeat if necessary. The hone will remove material from the cavity walls and should not be overused. Piston bore life will typically allow 8-10 maintenance cycles before nonpressure housing replacement is necessary. Replacement will be evident by an inability of the piston cavity to hold air pressure. Additional instructions for the operation of the carbide hone are contained within the piston maintenance kit.

9. After cavity cleaning, the piston itself should be inspected. Check O-rings for wear and replace if necessary. Apply a generous amount of 100% Silicone grease (Dow DC4 or equivalent which is provided in the maintenance kit) to the upper and lower O-Rings (part # 8 & 10 on Figure 3). Also apply a coat of lubricant to the walls of the piston cavity.

10. Prior to replacing the piston a brief inspection of the push rod rack should be accomplished. Backing off the slack adjustor will allow for movement of the push rod and a visual check of at least part of the push rod as it travels through the piston cavity. There should not be any wear on the push rod teeth and they should appear sharp. Proper installation and operation of the ITI precludes wear on the push rod. Evidence of wear can be further investigated by a disassembly of the rear housing. Its presence suggests contact be made with an ITI representative (1-800-231-0799 or 1-713-641-2300).

11. After the push rod inspection, insert the piston assembly (#9) back into the brake. Ensure that the key-way or slot on the piston assembly lines up with the protrusion (boss) in the brake cylinder piston housing (cavity). After proper alignment push assembly (#9) down until it bottoms out.

12. Complete procedure by reversing steps 1-5 with the exception of omitting step 3. Insert snap ring; back off caging nut; replace emergency delivery line to brake; air-up system. The cover cap needs to remain off until the system can be checked for proper operation. If a system checkout is not going to be made replace the brake cover cap.

13. Check system for air leaks.

14. Check system for proper operation.

15. Replace cover cap.

SYSTEM OPERATION CHECK

Power vehicles:

(1) Start to air up vehicle.
  (a) Wet Primary and Secondary tanks should air up simultaneously.

(2) At 65 psi or greater auxiliary tank should fill.

(3) Fully air up vehicle (at least 90 psi).

(4) Push in park brake control valve to release vehicle.

(5) Place air gauge in test port of ITI brake (opposite push rod).

(6) Park vehicle.
  (a) Gauge should read 45psi (some valves have higher pressures) and stop.
  (b) Locking pistons should engage **AFTER** brake applies.

(7) Wait for one minute.
  (a) Gauge should remain steady.

(8) Release parking brakes.
  (a) Watch gauge closely, peak pressure of at least 60 psi should occur.

(9) Drain wet tank.
  (a) All other tanks should remain full.
  (b) Brakes should remain released.
  (c) All service (Foot) brakes should remain functional.

(10) Drain Suspension (Auxiliary) tank.
  (a) All other tanks except wet tank should remain full.
  (b) Brakes should remain released.
  (c) All service (Foot) brakes should remain functional.

(11) Drain Primary tank.
  (a) Secondary tank should remain full.
  (b) Brakes should remain released.
  (c) Low air buzzer should sound at 80 psi.
  (d) Front and rear service brakes should remain functional.

(12) Drain Secondary tank.
  (a) Brakes should automatically apply at 60 psi. when Park Brake Control (Push Pull) Valve applies.
  (b) Gauge should read 45 psi and pistons should engage.
  (c) Gauge should slowly drop to zero.

(d) Brakes should remain mechanically locked and applied.

(13) Air up vehicle

(14) Drain Secondary Tank.
(a) Brakes should remain released.
(b) Rear service brakes should remain functional.
(c) Low air buzzer should sound at 80 psi.
(d) All tanks except wet and Secondary tanks should remain full.

(15) Air up vehicle.

(16) Drain Primary Tank.
(a) All tanks except wet tank should remain full.
(b) Brakes should remain released.
(c) Low air buzzer should sound at 80 psi.
(d) Front and rear service brakes should remain functional.

(17) Drain both Primary and Secondary tanks simultaneously.
(a) Low air buzzer should sound at 80 psi.
(b) Brake should apply at 60 psi. when park brake control valve pops.
(c) Air should continue to drain.
(d) brakes should remain mechanically locked.

(18) If you have any questions or are not sure of the test procedure please call at 1-800-231-0799.

Trailers

(1) Place air gauge in test port of ITI brake (opposite push rod).

(2) Start to charge trailer through emergency line.
(a) Tanks should air up.

(3) At 65 psi auxiliary, and in some configurations secondary, tank should fill.

(4) Brakes will release at 60-70psi.

(5) Fully air up vehicle (at least 90 psi).

(6) Park trailer by taking air off emergency line.
(a) Gauge should read 40-45psi and stop.
(b) Locking pistons should engage **AFTER** brake applies.

(7) Wait for one minute.
(a) Gauge should remain steady.

(8) Release parking brakes.
(a) Watch gauge closely peak pressure of at least 60 psi should occur.

(9) Park trailer and drain all air off trailer.
(a) Brakes should remain applied and mechanically locked.

ADDITIONAL SUGGESTED INSPECTION PROCEDURES

BRAKE DIAPHRAGM INSPECTION OR REPLACEMENT

A brake diaphragm inspection can easily be integrated into a 6 month preventive maintenance schedule or on an annual basis. The procedures are simple and they can be accomplished either with air on the system or without. Both methods have been included in the following section.

NOTE: If the brake diaphragm inspection is done during the inspection cycle of the brake piston assembly, ENSURE THE PISTON ASSEMBLY IS IN PLACE AND THE BRAKE IS UNCAGED PRIOR TO THE REMOVAL OF THE BRAKE'S CLAMPBAND. Removing the clampband with the push rod not locked in place or brake out of adjustment will allow the return spring to put back pressure on the pressure housing.

METHOD 1

1. Chock vehicle and activate parking brake. Air down system. Exhaust any trapped air.

CAUTION: WHEN LOOSENING CLAMPBAND DO NOT POSITION BODY IN FRONT OF THE BRAKE CHAMBER.

2. Disconnect clamp band (part numbers 17, 18, 26 on Figure 3) by turning flange nut (#17) counterclockwise.

3. Remove pressure housing (#23 on Figure 3).

4. Remove rubber brake diaphragm (# 22) and inspect for wear on surface. Replace as required.

5. Apply a coat of silicone spray on both sides of the new diaphragm for easy assembly and place in brake.

6. Reassemble brake by affixing the clamp band and tightening the clamp band nut (#17) in a clockwise direction (torque both nuts to 30 ft. lbs.)

CAUTION: WHEN REPLACING PRESSURE HOUSING MAKE SURE IT IS PROPERLY ALIGNED AND THAT THE CLAMPBAND PROPERLY ENCLOSES ALL EDGES OF THE PRESSURE AND NON-PRESSURE HOUSINGS (# 23 AND #19). A RUBBER MALLET OR HAMMER CAN BE USED TO GENTLY TAP BOTH THE PRESSURE HOUSING AND CLAMPBAND TO ENSURE THE CLAMPBAND IS MAKING ADEQUATE CONTACT WITH BOTH HOUSINGS.

METHOD 2

1. Chock vehicle. Air up system and release the parking brake.

2. Take brake out of adjustment by backing off the slack adjuster until push rod is at full stroke (push rod will just begin to move).

3. Disconnect clamp band (part numbers 17, 18, 26 on Figure 3) by turning flange nut (#17) counterclockwise.

4. Remove pressure housing (#23 on Figure 3).

5. Remove rubber brake diaphragm (# 22) and inspect for wear on surface. Replace as required.

6. Apply a coat of silicone spray on both sides of the new diaphragm for easy assembly and place in brake.

7. Reassemble brake by affixing the clamp band and tightening the clamp band nut (#17) in a clockwise direction (torque both nuts to 30 ft. lbs.)

WARNING: DO NOT STAND NEAR THE BRAKE CHAMBER WHEN AIR TESTING.

8. Air up system and check for both air leaks and proper operation of the brake.

CAUTION: WHEN REPLACING PRESSURE HOUSING MAKE SURE IT IS PROPERLY ALIGNED AND THAT THE CLAMPBAND PROPERLY ENCLOSES ALL EDGES OF THE PRESSURE AND NON-PRESSURE HOUSINGS (# 23 AND #19). A RUBBER MALLET OR HAMMER CAN BE USED TO GENTLY TAP BOTH THE PRESSURE HOUSING AND CLAMPBAND TO ENSURE THE CLAMPBAND IS MAKING ADEQUATE CONTACT WITH BOTH HOUSINGS.

COMMON BRAKE PART REPLACEMENTS

The preceding section covered brake inspection procedures and the replacement of a brake diaphragm. One of the many advantages to the ITI brake is that it can be completely rebuilt on the axle. In conjunction with the preceding section, this chapter will cover the replacement of most of the common parts of the brake chamber.

CLAMPBAND

1. Chock vehicle and activate parking brake. Air down system. Disconnect emergency line between the ITI Control Valve (CV) and the ITI brake at the brake housing or the "in" port of the externally mounted double check valve to exhaust any trapped air.

CAUTION: WHEN LOOSENING CLAMPBAND DO NOT POSITION BODY IN FRONT OF THE BRAKE CHAMBER.

2. Disconnect clamp band (part numbers 17, 18, 26 on Figure 3) by turning flange nut (#17) counterclockwise.

3. Install new clampband and tighten flange nut in a clockwise direction.

CAUTION: WHEN REPLACING PRESSURE HOUSING MAKE SURE IT IS PROPERLY ALIGNED AND THAT THE CLAMPBAND PROPERLY ENCLOSES ALL EDGES OF THE PRESSURE AND NON-PRESSURE HOUSINGS (# 23 AND #19). A RUBBER MALLET OR HAMMER CAN BE USED TO GENTLY TAP BOTH THE PRESSURE HOUSING AND CLAMPBAND TO ENSURE THE CLAMPBAND IS MAKING ADEQUATE CONTACT WITH BOTH HOUSINGS.

4. Air up system and check for both air leaks and proper operation of the brake.

O-RING REPLACEMENT

This procedure can be accomplished in conjunction with the piston assembly inspection to be performed every 6 months or 100,000 miles. Be sure to use ITI spare parts for proper fit and the required air seal.

1. Engage the parking brake and chock the wheels so that the vehicle does not move.
2. Drain air from the system tanks.

3. Remove the piston assembly cover cap. Some models have a cap attached by a 1/4 20 screw (3/8" socket), others have a cap which threads into the housing.

WARNING: AFTER STEP (4) IS COMPLETED THE MECHANICAL LOCK ENGAGING THE PUSH ROD WILL BE UNLOCKED AND THERE WILL BE NO PARKING BRAKE APPLICATION FROM ANY CHAMBER SO UNLOCKED. CHOCK THE VEHICLE NOW IF IT HAS NOT BEEN DONE PRIOR TO THIS STEP.

4. Cage the brake by tightening the caging bolt on the piston assembly. The caging nut is part number #5 located on Figure 3. Approximately 4 to 5 turns should be necessary. Do not overtighten.

5. Remove the piston snap ring (part #4 on Figure 3) by using the proper snap ring pliers.

6. Lift the piston assembly (part #9) from the brake piston cylinder housing by gripping the caging nut (#5) with a pair of pliers and pulling it straight out. Do not crush caging bolt threads.

7. Remove old O-rings (part #'s 8 & 10) and replace with ITI upper and lower O-rings. Ensure a generous amount of 100% Silicone lubricant has been applied to the O-rings themselves. Also apply a coat of lubricant to the walls of the piston cavity.

WARNING: DO NOT USE ANY SUBSTITUTE LUBRICANT.

8. Insert the piston assembly (#9) back into the brake. Ensure that the key-way or slot on the piston assembly lines up with the protrusion (boss) in the brake cylinder piston housing (cavity). After proper alignment push assembly (#9) down until it bottoms out.

9. Complete procedure by reversing steps 1-5: insert snap ring; back off caging nut; replace cover cap; replace emergency delivery line to brake; air-up system.

10. Check system for air leaks and proper operation. Follow system operation checks procedures.

REPLACEMENT OF PISTON ASSEMBLY

Follow steps for O-ring replacement as described in the previous section with the exception of step 7 to read:

7. Replace old piston assembly with new ITI piston assembly. Ensure that both O-rings and the piston cavity walls are lubricated. Remove all dirt and contaminants as described in the Semiannual preventive maintenance check prior to the insertion of the new piston assembly.

REPLACEMENT OF PUSH ROD AND/OR RETURN SPRING

1. Engage the parking brake and chock the wheels so that the vehicle does not move.

2. Drain air from the system tanks.

3. Remove the piston assembly cover cap. Some models have a cap attached by a 1/4 x 20, 3/8 head screw, others have a cap which threads into the housing.

WARNING: AFTER STEP (4) IS COMPLETED THE MECHANICAL LOCK ENGAGING THE PUSH ROD FOR THE CHAMBER BEING WORKED ON WILL BE UNLOCKED AND THERE WILL BE NO PARKING FORCE APPLIED TO THE VEHICLE FROM THIS CHAMBER. CHOCK THE VEHICLE NOW IF IT HAS NOT BEEN DONE PRIOR TO THIS STEP.

4. Cage the brake by tightening the caging bolt on the piston assembly. The caging nut is part number #5 located on Figure 3. Approximately 4 to 5 turns should be necessary. **Do not overtighten.**

CAUTION: WHEN LOOSENING CLAMPBAND DO NOT POSITION BODY IN FRONT OF THE BRAKE CHAMBER.

5. Remove the clampband by loosening the flange nut (#17) by turning it in a counterclockwise direction.

6. Remove the pressure housing and diaphragm by following proper instructions.

7. Remove the cotter and clevis pins (part # 14 Figure 3) which attaches the push rod to the slack adjuster. Move end of slack adjuster out of the yoke by turning the adjustment nut.

8. Remove the clevis yoke and jam nut (#12 Figure 3) by first loosening the jam nut (#13) and then unscrewing it from the threaded rod.

9. Remove the push rod from the chamber. At this time either the push rod or the return spring can be replaced.

10. If replacing the return spring ensure the small end of the spring is located inside the recessed area of the non-pressure housing (# 19).

11. If replacing the push rod ensure it is cut to the proper push rod length and that it is inserted with the push rod teeth facing toward the piston chamber. Clean inside of housing if appropriate.

CAUTION: MAKE SURE PUSH ROD TEETH FACE UP TOWARD THE PISTON CAVITY

12. Uncage the brake by turning the caging nut (part #5) in a counterclockwise direction until it is flush with the top of the caging bolt.

13. Compress the push rod manually.

14. Reassemble the brake by reversing steps 1-8 with the exception that step #4 has already been reversed. Remember:

CAUTION: WHEN REPLACING HIGH PRESSURE HOUSING MAKE SURE IT IS PROPERLY ALIGNED AND THAT THE CLAMPBAND PROPERLY ENCLOSES ALL EDGES OF THE PRESSURE AND NON-PRESSURE HOUSINGS (# 23 AND #19). A RUBBER MALLET OR HAMMER CAN BE USED TO GENTLY TAP BOTH THE HIGH PRESSURE HOUSING AND CLAMPBAND TO ENSURE THE CLAMPBAND IS MAKING ADEQUATE CONTACT WITH BOTH HOUSINGS.

15. After system is aired up, check for leaks and for the proper operation of the system.

ITI CONTROL VALVE
SYSTEM OVERVIEW

The ITI Control Valve (CV) is used as part of ITI's brake system. The CV comes in three models designed for use in tractors, trailers and buses. The tractor and truck/bus models differ only with respect to the settings of several internal components while the trailer model incorporates an additional internal pressure protection valve and its related piping.

WARNING: THE DIFFERENT MODELS OF THE ITI CONTROL VALVE DO NOT VARY IN EXTERNAL APPEARANCE. THEIR USE IS NOT INTERCHANGEABLE AND POWER VEHICLE VERSIONS SHOULD NOT BE USED ON TRAILERS NOR SHOULD TRAILER MODELS BE USED ON POWER VEHICLES.

A label has been affixed (vertically oriented) to the side of the valve immediately above the lockport delivery. This label identifies the type of valve model, the part number of the valve, and the serial number of the valve. In addition, it is color coded with red labels used for trailers, green for tractors, and yellow for straight trucks and buses.

The overall purpose of the ITI Control Valve is to provide proper functioning of an air-applied mechanically held brake system under all parking and emergency operating conditions.

OPERATION WITH POWER VEHICLES

The tractor and the straight truck/bus models have identical functionality and differ only in the operating pressures which are set by ITI at the point of manufacture. Since trucks and buses do not have the advantage of the braking capability of a corresponding trailer, the parking and emergency requirements both set by the government and the vehicle manufacturers are more stringent than for that of a tractor. Since system operation is identical, they have been grouped for discussion purposes and may be referred to as power unit models.

INITIAL CHARGING

Air is supplied to the CV valve through the ports labeled: emergency "EMR", primary reservoir "PRM RES", and secondary reservoir "SEC RES". In a power vehicle the reservoirs are charged directly from the compressor through a series of check valves. The air lines from the reservoirs to the valve provide it access to those air sources for parking and emergency applications. The EMR port can be considered the supply line connection and it is usually routed from the park brake control or "push-pull" valve. It is important to note that the park brake control valve is normally supplied by both the primary and secondary reservoirs. The ITI control valve must be supplied air by the same sources that feed the park brake control valve. During the charge sequence, the CV ports air to both the brake diaphragms (via relay valves) and the locking piston chambers. Air on the brake diaphragm relieves frictional pressure on the mechanical piston lock allowing the air pressure in the piston chamber to disengage the mechanical lock. The brakes are still applied since there is still air on the brake diaphragm. When supply line and thus tank pressure reaches a preset limit, the CV goes into exhaust, dumping air off the brake chamber effecting a clean brake release.

SERVICE APPLICATION

The CV is designed to provide parking and emergency application capability to an air brake system. In normal service operation the CV is not used as an active part of the system. Service modulation can be provided, but it is dependent on air system design and its use is at the discretion of vehicle manufacturers. Contact ITI or your vehicle manufacturer for details. Service applications are controlled and powered through the service relay valve or direct from the treadle valve.

BALANCE PORT FUNCTION

The valve does have a balance port which is located directly over the EMR port and can be readily identified by its hexagonal fitting. There is a label for this port on the top of the valve surface pointing to it. The balance port is normally connected to a delivery or control line of the service relay valve. The CV will therefore prevent the vehicle from being parked at a greater than desired pressure.

PARK APPLICATION

A park application is initiated by exhausting air off the supply line (emergency line). When the CV senses the supply line pressure drop it ports air from either the primary or secondary reservoirs at a controlled pressure to the brake chambers. This applies the brakes. This same supply line pressure signal activates a synchronizing device which engages the mechanical pistons immediately after the brakes have been applied. A back-up method of applying the pistons has been provided to ensure their operation.

BRAKE RELEASE WITH SYSTEM PRESSURE CHARGED

A brake release after a park application is similar to that of an initial charging and release of the brakes with the exception that the air tanks are already pressurized. Activation of the park brake control valve sends a pressure signal to the CV. The CV will then provide the necessary air pressure to the brake chamber diaphragms to relieve any possible back pressure on the mechanical pistons. This allows air pressure on the piston cavities to smoothly disengage the brake's mechanical lock. The CV then exhausts air from the brake chamber effecting a clean and smooth release.

EMERGENCY APPLICATION

The ITI system contains multiple means of emergency application in the event of an air leak. The ITI Control Valve is fed air from both the primary and secondary reservoirs. These reservoirs are internally protected within the valve through the use of one way check valves. Therefore, if air pressure is lost from a single reservoir, the other reservoir can power the valve through a full range of applications. Dash mounted devices should warn the driver of an air pressure loss from one side of the system and a safe stop accomplished. The CV will also provide for an automatic application, if necessary.

In a low air situation after both low air buzzers sound the park brake control or "push pull" valve will "pop", thereby exhausting air from the supply line and applying the brakes. If this valve fails, the CV will sense a lowering of pressure in both reservoirs and an automatic application is made when system

pressure reaches a preset limit. This will also simultaneously engage the brake's mechanical lock.

CAUTION: FOR TRUCKS, TRACTORS, AND BUSES IT IS IMPORTANT THAT AIR RESERVOIRS SUPPLYING THE ITI CONTROL VALVE ARE THE SAME ONES AS SUPPLYING THE PARK BRAKE CONTROL OR "PUSH-PULL VALVE" AND ALL OTHER VALVES INVOLVED IN THE PARK/EMERGENCY FUNCTIONS.

OPERATION WITH TRAILERS

The trailer version of the ITI Control Valve (CV) is very similar to the power vehicle models. The main difference is that unlike a tractor, a trailer's reservoirs are filled through the CV valve rather than directly from a compressor. Provisions have been made to accomplish this while protecting one reservoir with the use of an internal pressure protection assembly.

INITIAL CHARGING

Air enters the trailer to the CV through a supply line referred to as the emergency line in a trailer. It should be connected to the "EMR" port on the valve and this line provides the air pressure for initial charging. During the charging sequence, air is routed to the emergency reservoir through a one way check valve. In addition, air is supplied to the air brake chamber diaphragms and the mechanical piston chambers. As pressure on the chamber diaphragms build, mechanical pressure on the brake's pistons is relieved and the air pressure in the piston chamber is sufficient to disengage the mechanical lock. The trailer's brakes are not released until air is exhausted off the air brake chamber diaphragms. This occurs at a safe preset level just before the secondary reservoir is filled. Other plumming options allow both tanks to be filled simultaneously prior to releasing the park brakes.

PARK OR BREAKAWAY APPLICATION

A park or breakaway application is initiated when the park brake control valve is activated or air pressure is exhausted off the trailer supply (or emergency) line. Normal system construction calls for the trailer service line (or control) to be connected to the CV's balance port located on top off the valve's emergency port and recognizable by its hexagonal fitting. This prevents the vehicle from being parked at a higher pressure than the desired pressure.

When the CV senses the supply (or emergency) line pressure drop it ports air from either the emergency or service reservoirs at a controlled pressure to the brake chambers. This applies the brakes. This same emergency line pressure signal activates a synchronizing device which engages the mechanical pistons immediately after the brake has been applied. A back-up method of applying the pistons has been provided to ensure their operation.

PARKING BRAKE RELEASE WITH SYSTEM FULLY CHARGED

A brake release after a park application is similar to that of an initial charging and release of the brakes with the exception that the air tanks are already pressurized. Activation of the park brake control valve sends a pressure signal to the CV. The CV will then provide the necessary air pressure to the brake chamber diaphragms to relieve any possible back pressure on the mechanical pistons. This allows air pressure on the piston cavities to smoothly disengage the brake's mechanical lock. The CV then exhausts air from the brake chamber effecting a clean and smooth release.

EMERGENCY APPLICATION

The CV will provide for an automatic application of the trailer brakes at anytime that the supply (or emergency) line air pressure drops to a preset level. For example, this occurs if the trailer suffers a "breakaway". In addition, if the emergency reservoir suffers a pressure loss this is transmitted to the supply (or emergency) line thereby activating the brakes. Automatic application is initiated by the CV which is fed by both reservoirs. The application itself is at a controlled pressure set by the valve and ported to the brake chambers. After brake application, the CV exhausts the piston chambers which engages the mechanical lock. The valve does have a back up means of engaging the mechanical pistons ensuring their operation.

In addition to the automatic operation of the CV, there are several safety warnings and actuation

systems to ensure the safe operation of the vehicle. Low air warning buzzers and warning lights should sound and activate in the cab, if trailer air pressure begins to fall. This provides the driver with time to apply the brakes and stop the vehicle. If these should fail or are ignored by the driver, the trailer park brake control valve should "pop" at a preset limit activating the trailer brakes through the CV. As discussed in the previous paragraph the CV itself contains a sensing device to automatically apply trailer brakes in the event of a low air situation or park brake control valve failure.

PREVENTIVE MAINTENANCE

Use system check procedure to verify the proper functioning of the ITI Brake System every 6 months, 100,000 miles or 3600 operating hours whichever comes first.

ITI BRAKE SYSTEM OPERATION

Introduction

The ITI brake system is an air-applied mechanically held parking and emergency brake whose function provides many advantages. It does however, operate quite differently than a conventional spring brake system and must be plumbed properly for correct operation. Vehicle manufacturers take this responsibility when delivering a new vehicle with ITI brakes installed at the point of manufacture. For fleets retrofitting brakes systems onto older vehicles, detailed retrofit instructions should be obtained from ITI (1-800-231-0799) or an authorized ITI distributor. This service manual is not intended to take the place of such instructions. However, an overview of system operation can be useful to the user and this section will provide it. Since the ITI can be used on many different types of vehicles several sections are included.

Overview

The section on the ITI Control Valve (CV) should be reviewed for it provides the outline of system function. This valve is the central control for the brake. Older systems and retrofits which incorporate other valving arrangements will be covered in separate sections. As mentioned in the CV section, there are a few guidelines which should be adhered to when installing the ITI brake system. They are:

1. The **same** air sources which feed the park brake control valve **must** feed the CV and all the valves involved in the parking sequence.

2. Both primary and secondary air sources should be connected to the CV. If a park tank is used it also needs to be connected to the valve.

3. Control line or signal to the service relay should be attached to the CV balance port.

Trailer System

A drawing of a representative tandem axle trailer system appears in Figure 6. This system is a "two tank three valve" installation with the CV controlling emergency and park applications and one service relay valve controlling service applications. Multiple axle installations can be made with additional valves and tanks.

As mentioned in the overview, trailer supply (or emergency) powers the CV with a control signal (trailer control or service) signalling the service relay valve. A balance line runs from a service relay delivery hose or control line to the balance port on the CV. Piston lines are run from the lockport's on the CV to the piston ports on the brake. Operation of the system conforms to that detailed in the CV section of the manual.

Power Vehicle

Figure 7 represents a typical power vehicle installation. Note that the park brake control valve is being supplied by both the primary and secondary tank. In turn a line from the park brake control valve is supplying the CV. Air lines have been run from both primary and secondary tanks to the CV. Brake pistons are being supplied air from the lockport's of the CV. Actual system operation has been outlined in the CV section of this manual.

An alternative configuration has been developed by ITI and individual OEM manufacturers will decide which system they want to use. The alternate configuration differs from the standard system in that a dedicated park tank has been included and this tank supplies the park brake control valve. The park brake control valve in turn supplies the CV. The park tank is attached to the CV reservoir port, the park brake control valve pressure level is monitored by the CV for automatic brake application. The front service tank provides secondary air and a balance line from its service delivery relay valve communicates with the balance port of the CV. System operation is similar with the exception that if the park tank loses air pressure an emergency application is initiated. In effect the park tank represents the primary dedicated air system.

OTHER VEHICLE CONFIGURATIONS

Trailer

While ITI recommends the use of its CV, it is possible that under certain conditions (such as a single tank trailer exempt from the US 121 standard) that an alternative system configuration may be used. The most common is one which employs both a Relay Emergency Valve and an Inversion Load Valve. Figure 8 shows the system. The Relay Emergency Valve (typically an RE-6) will provide an emergency application if supply line or tank pressure drops to a preset limit. The piston lines are plumbed off the reservoir so that if tank pressure continues to decrease, the mechanical lock will engage.

The inversion load valve is used to ensure a clean brake release upon initial air charging and after a park application. The inversion load valve will allow pressure to build up on the service piston of the relay emergency valve ensuring the brake chambers receive a preset pressure of 60-65 pounds. At this point the valve goes into exhaust. While the system is initially charging, air pressure also flows through the emergency port to the relay emergency valve and on into the reservoir. When the inversion load valve builds to its release pressure it removes the control signal from the relay emergency valve and thus air is exhausted from the brake chamber. This releases the brake. During normal service operation of the vehicle any control signal sent via the service line is transmitted through the double check valve to the relay emergency valve and an application is made.

Some older ITI systems use just the Relay Emergency Valve. While these systems provide all necessary functions, it sometimes takes a trailer service brake application to release the mechanical locking pistons. For this reason ITI strongly suggests that the inversion load valve assembly be used in conjunction with a Relay Emergency Valve (contact ITI at 1-800-231-0799, or 1-713-641-2300 for details if necessary).

OTHER RETROFIT SYSTEMS

Unlike the truck and trailer producers, many bus and coach manufacturers are using or have used air-applied mechanically held brakes in the past (Bendix DD3). Therefore many buses already have the necessary valving in place for the retrofitting of the ITI brake. As mentioned earlier, this service manual is not intended to serve as a retrofit installation manual. However in the interest of completeness details on its operation will be included.

As with all air-applied systems, some type of inversion valve must be used to ensure that an automatic application is made in the event of air pressure loss. Inversion valves operate in such a manner that the absence of a control signal allows supply air to flow to delivery. ITI systems used on buses incorporate existing inversion valves for operation. In addition, the emergency and park application should be made at a controlled pressure. This will aid in brake release and for a controlled application in the event of emergency. Pressure reducing valves are either inserted into the system or utilized if already installed.

Figure 9 shows ITI installed on a bus with a TR-2 inversion valve. As with all ITI systems, the same air source(s) feeding the park brake control (push-pull) valve must be feeding the inversion valve and the park brake relay valve. In this case a dedicated park tank feeds both. This system does contain a pressure reducing valve upstream of the inversion valve to control park and emergency application pressure.

The one major addition to this system is the insertion of a by-pass valve into the lockport lines. The by-pass valve is used for proper timing of the application of the brake and the mechanical engagement of the ITI piston. The lockport lines run between the piston chamber and into a common control port on

the inversion valve. Initiation of the park or emergency sequence starts with the exhausting of the control line from the park brake control or "push-pull" valve to the inversion valve. Since the lockport line shares a common manifold with the park brake control valve line, this will exhaust the lockport line and apply the piston. Applying the piston at the same time that the inversion valve applied the brake would create wear on the push rod, since the push rod would be traveling under the piston cavity at the same time that the piston would be forced against it by spring pressure. The design of the piston and push rod teeth would allow the push rod to extend under these conditions (but not retract). However, such motion would create wear. To eliminate this the by-pass valve exhausts the air from the lockport line slow enough so that the piston engages the push rod right after it has been applied.

CAUTION: IT IS IMPORTANT THAT THE CORRECT BY-PASS VALVE FOR THE LOCKPORT LINE AIR VOLUME BE SELECTED. WHEN USING A LARGE LOCKPORT LINE (BRAKE HOSE WITH LARGE DIAMETER (1/2 TO 5/8") A 110186 SEALCO BY-PASS VALVE SHOULD BE USED. THE NUMBER CAN BE READ ON THE SIDE OF THE VALVE. WHEN USING BRAKE TUBING OF 3/8" DIAMETER A TYPE 110183 SEALCO BY-PASS VALVE SHOULD BE USED. IN ADDITION, THE ARROW ON THE BY-PASS VALVE (UNDER THE SEALCO NAME) SHOULD BE POINTING IN THE DIRECTION OF THE BRAKE. IF ANY NOISE OR RACHETING OCCURS UPON APPLICATION OR RELEASE OF THE PARKING OR SERVICE BRAKE, CONTACT ITI IMMEDIATELY.

Another typical bus installation has been presented in Figure 10. This drawing shows the use of a "TR3" inversion valve. The major difference between the TR2 and TR3 is that the TR3 has only one control, delivery, and supply port while the TR2 has multiple ports. The TR2 can also be identified by its hexagonal shape. Often, the original bus will have multiple TR3's for timing. Our system requires only one TR3 for operation. In this drawing the TR3 signals a relay valve for its application. A pressure reducing valve has been added to the system downstream of the inversion valve delivery to control application pressure. As with the previous system a by-pass valve has been added for timing. THE SAME CAUTION AS TO BY-PASS VALVE AND LOCKPORT VOLUME COMPATIBILITY NEEDS TO BE FOLLOWED AS IS COVERED IN THE PREVIOUS SECTION.
ITI does have a standard power vehicle which utilizes a dedicated park tank. Figure 11 is a schematic of this set up. Individual manufacturers have the discretion to use this system or one which uses a standard FMVSS121 arrangement.

DRIVE LINE SYSTEMS

The inversion valve senses any loss of control pressure in the supply line which comes from the park brake control valve. An automatic application is made if it falls to a preset limit or it is exhausted manually for a park application. The application itself is made through the park brake relay valve. This valve receives a signal which has been made at an adjustable pressure controlled by the pressure reducing valve. Airflow is from the delivery port of the inversion valve through the pressure reducing valve to the control port of the relay valve. This control signal sends an application to the brakes through the relay valve's delivery lines.

Treadle valve modulation of the park brake is accomplished by sending a signal from the treadle valve to the balance port on the relay valve. The balance port acts as a double check valve between the control signal coming from the inversion valve and the control signal coming from the inversion valve.

The bypass-valve is plumbed from the supply line coming from the park brake control "push-pull" valve. Any loss of air pressure in this line such as when it is exhausted manually for a park application, will exhaust air off the pistons and engage the brake's mechanical lock. The by-pass valve sequences the piston engagement. As with certain bus systems:

CAUTION: IT IS IMPORTANT THAT THE CORRECT BY-PASS VALVE FOR THE LOCKPORT LINE AIR VOLUME BE SELECTED. WHEN USING A LARGE LOCKPORT LINE (BRAKE HOSE WITH LARGE DIAMETER 1/2 TO 5/8") A 110186 SEALCO BY-PASS VALVE SHOULD BE USED. THE NUMBER CAN BE READ ON THE SIDE OF THE VALVE. WHEN USING BRAKE TUBING OF 3/8" DIAMETER A TYPE 110183 SEALCO BY-PASS VALVE SHOULD BE USED. IN

ADDITION, THE ARROW ON THE BY-PASS VALVE (UNDER THE SEALCO NAME) SHOULD BE POINTING IN THE DIRECTION OF THE BRAKE.

TROUBLE SHOOTING CHART

Symptom	Corrective Action
(1)Leaking Service Relay Valve (park brakes released)	(a) Replace service relay valve.
(2)Leaking Service Relay Valve (park brakes applied)	(a) Replace service relay valve. (b) Call ITI for help.
(3)Leaking Piston	(a)Inspect O-rings and brake housing by following procedure in the maintenance manual. If the O-rings are damaged replace them. If the piston is damaged replace it and if the housing is damaged replace the entire brake.
(4)Leaking system (will not hold air when parked)	(a) Use attached leak test procedure to find the leak and fix the leak.
(5)Leaking clamp band	(a)Tighten clamp band. If this does not work follow procedure in the maintenance manual.
(6)Leaking Control valve	(a)Cycle valve several times and inspect for dirt. If valve continues to leak replace the valve with the same valve part number.
(7)Cracked housing	(a)Replace brake following procedure in the maintenance manual.
(8)Worn pistons	(a)Make sure that push rod is running straight in housing. If the push rod is crocked it can be straightened by loosing the jam nut and straightening it. Make sure to inspect the Non-pressure housing and if it is damaged replace it. Also replace the pistons following procedure in the maintenance manual and correct alignment. (b)Remove cover cap. Park the vehicle and watch to make sure that the brake is fully applied prior to the piston engaging. If the piston is dropping early contact I.T.I. at (713)-641-2300. (c)Check alignment shown in the maintenance manual. If the alignment is incorrect and the vehicle has been run this way all chambers need to be inspected for damage and replaced if necessary. If there is no damage to the chamber then replace the pistons following procedure in the maintenance manual and correct the alignment.
(9)Missing cover cap	(a)Check piston for leak with the brakes released. If the piston leaks follow procedure number "3" on previous page. (b)Clean piston, piston bore and cover cap.

	(c) Replace cover cap and make sure to replace all cover caps on all other brakes.
(10)Pistons not moving	(a)Make sure brakes are NOT caged. If brakes are caged then the piston will not move and you will not have parking brakes. (b)Inspect pistons following procedure in the maintenance manual. Order a piston maintenance kit and contact I.T.I. personal at (713) 641-2300 to insure that installation is correct.
(11)Can't cage brake	(a)Follow procedure in the maintenance manual. If the brake will still not release then contact I.T.I. at (713)-641-2300.
(12)All brakes won't release	(a)Place air gauge in the emergency line near the Control Valve. Apply air to the emergency glad hand. Read the gauge and make sure that there is at least 80 psi. on the gauge. If there is less then 80 psi and the vehicle needs to be moved follow manual caging instructions in the maintenance manual. (b)Verify that system is plumed correctly by contacting I.T.I. personal at (713)-641-2300. (c)Place gauge in front port (furthest port from the push rod) and follow system test procedure on attached page. If parameters are not correct replace the Control Valve and contact I.T.I. personnel at (713)-641-2300.
(13)Parking brakes slow to release.	(a)Place air gauge in the emergency line near the Control Valve. Apply air to the emergency glad hand. Read the gauge and call I.T.I. at (713)-641-2300.
(14)One tire not releasing	(a)If problem is random (not always the same brake) follow step (b). If the problem is only on one wheel perform step (b) to verify that system is functioning correctly and then perform step (c). (b)Place gauge in front port (furthest port from the push rod) and follow system test procedure on attached page. If parameters are not correct replace the Control Valve and contact I.T.I. personnel at (713)-641-2300. (c)Check push rod alignment. Make sure that push rod is running straight in housing. Check piston assembly. Check foundation brake components.
(15)Installation problems	(a)Contact I.T.I. (713)-641-2300.

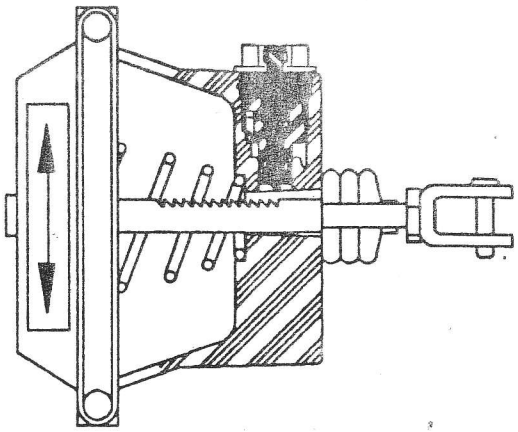


FIG. A BRAKES UNAPPLIED

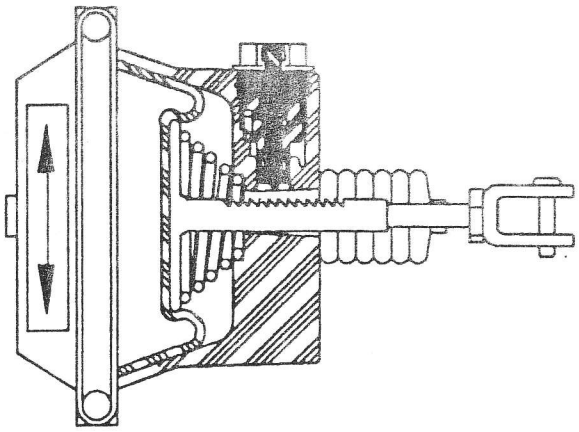


FIG. B SERVICE APPLICATION

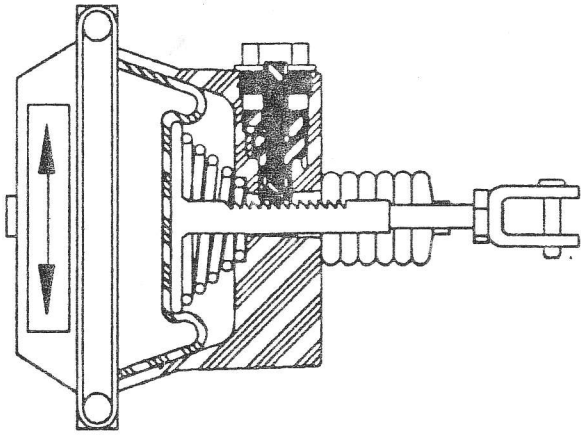


FIG. C PARK/EMERGENCY
(AIR AND MECHANICAL LOCK)

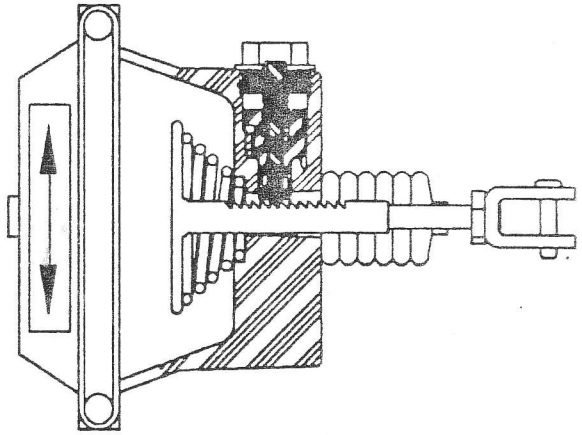


FIG. D PARK/EMERGENCY
(MECHANICAL LOCK ONLY)

Figure 1. Brake Operation.

Figure A shows the brake in an unapplied position and with the piston assembly pressurized and not mechanically locked. This represents a normal vehicle operating condition. Figure B depicts a typical service application. Figure C demonstrates an air application with the mechanical lock in place. This would occur after a park or during an emergency. Figure D shows such an application if air pressure continued to decrease. Figure E is a more detailed look at the piston and pushrod.

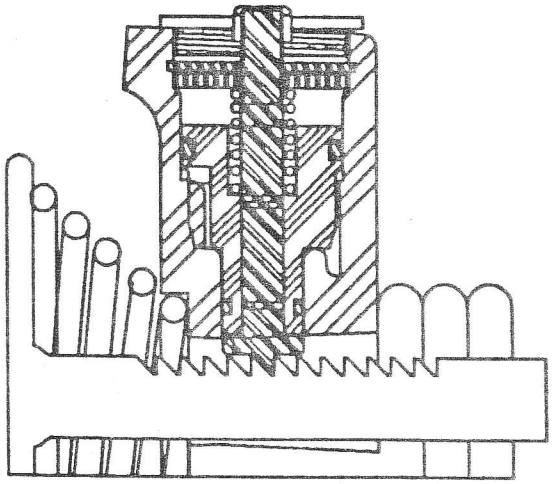


FIG. E DETAILED VIEW OF PISTON
AND PUSHROD ASSEMBLY

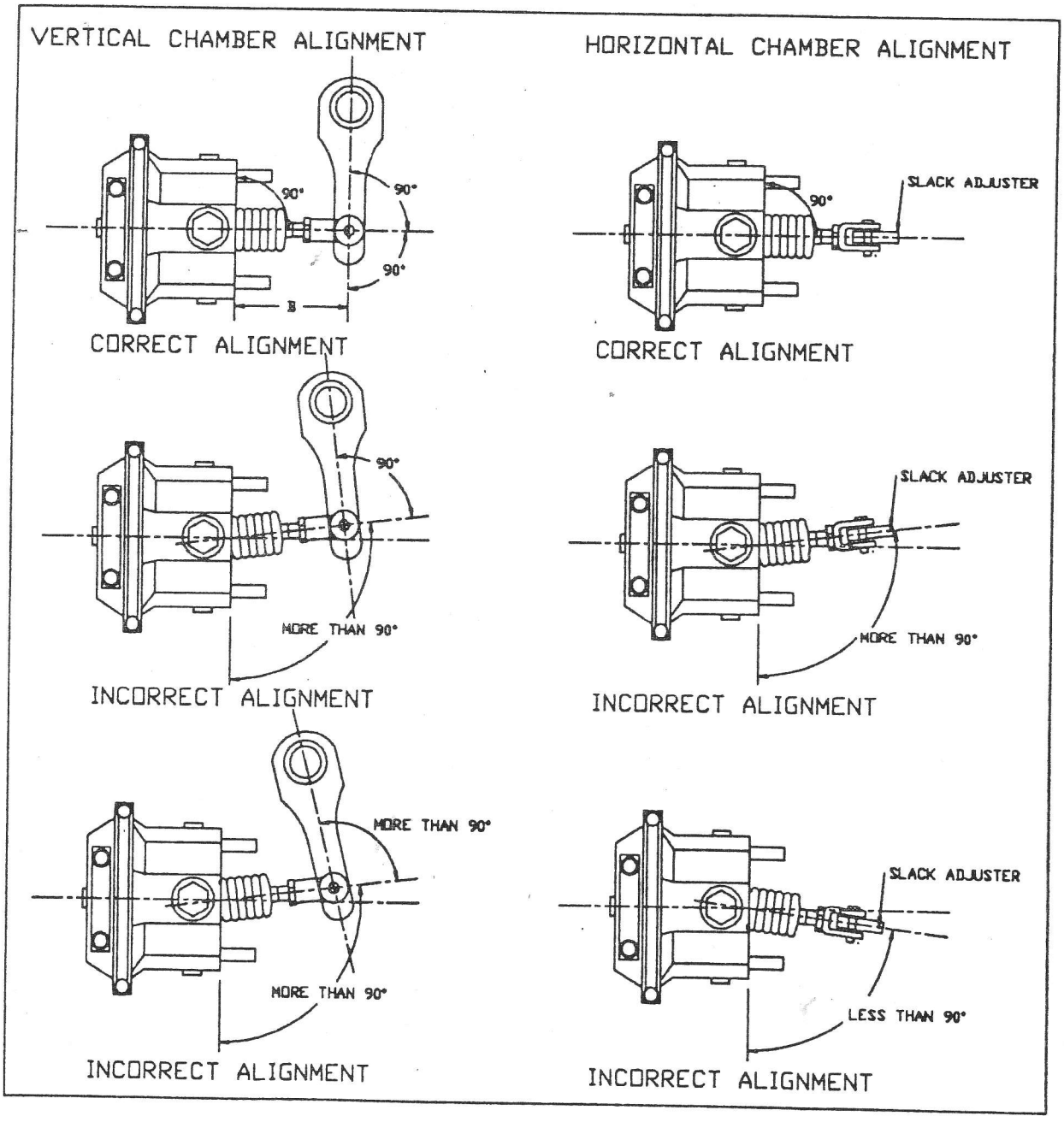


Figure 2: Correct and Incorrect Alignment of the Mini-Max Chamber

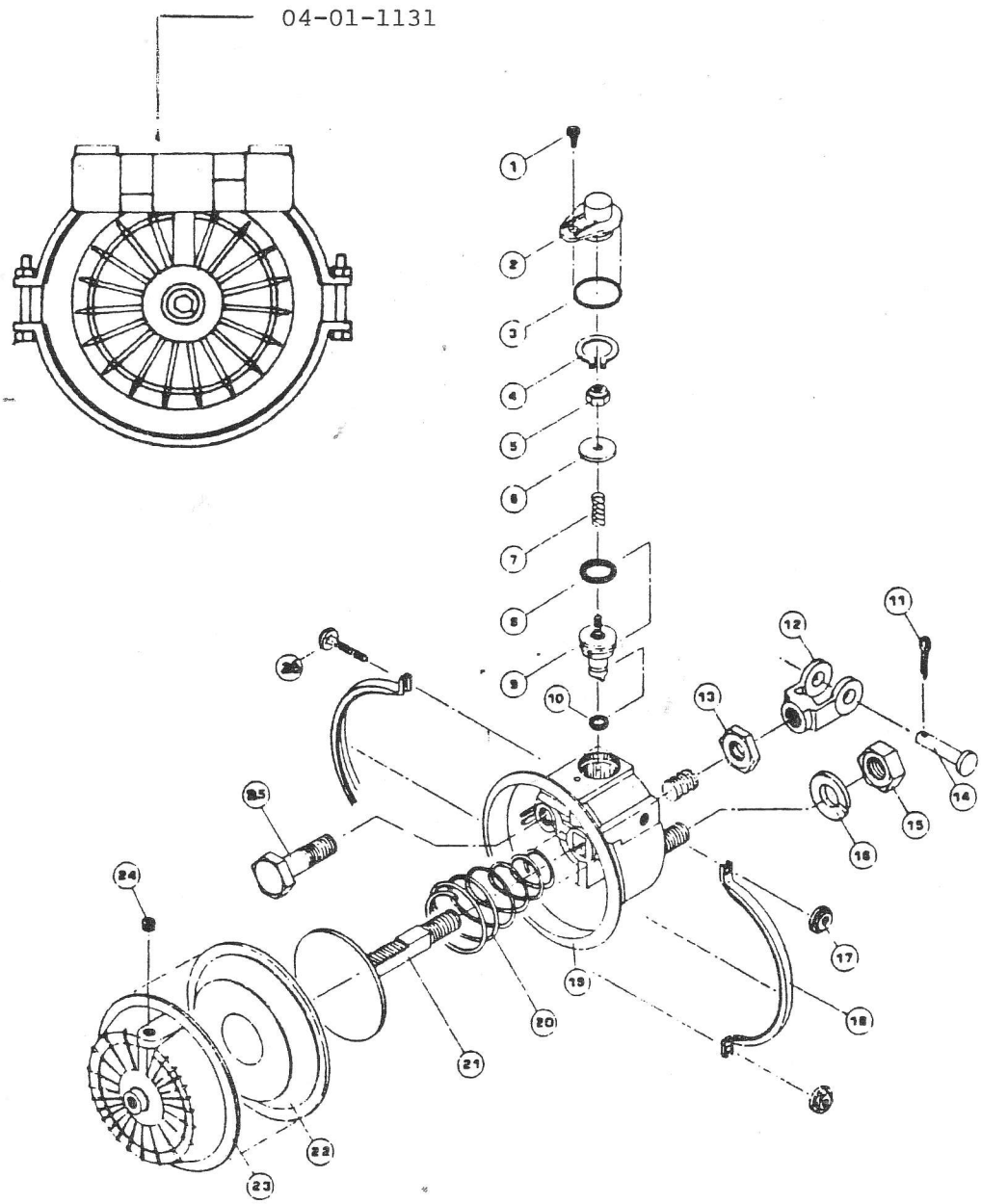
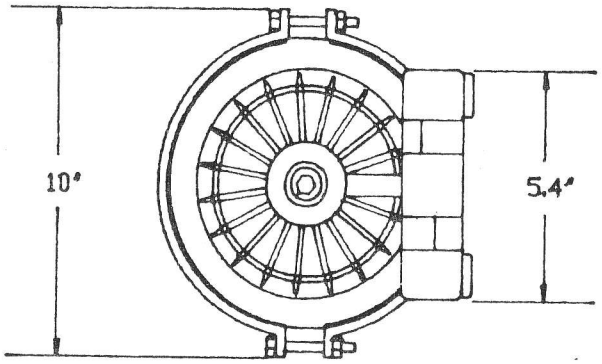


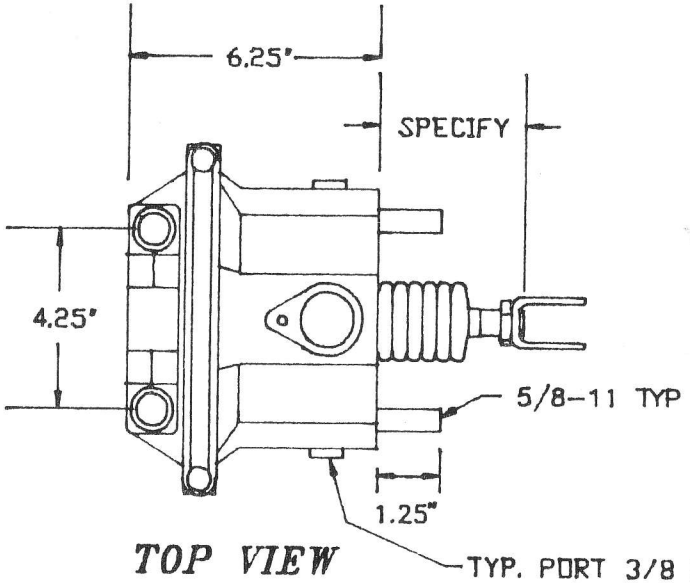
Figure 3. Assembly View of the Mini-Max Brake Chamber.

Mini-Max Subcomponent Parts List

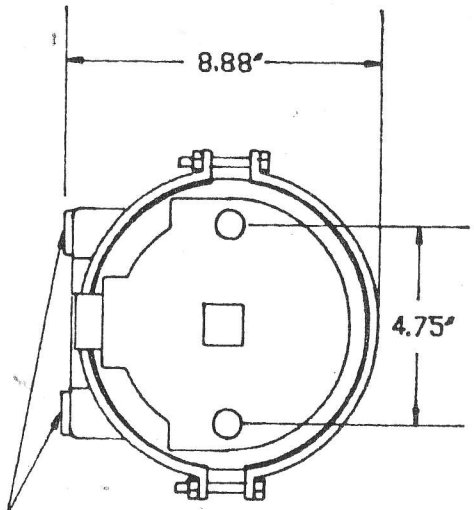
Item No.	Part Number	Description	Item No.	Part Number	Description
1	04-01-1005	Cover Cap Screw	15	04-01-1075	Nylock Hex Nut
2	04-01-1010	Cover Cap	16	04-01-1080	Hardened washer
3	04-01-1015	O-Ring Cover Cap	17	04-01-1085	Flange Nut, Clamp Ring
4	04-01-1020	Snap Ring (Piston)	18	04-01-1090	Clamp Ring 1/2
5	04-01-1025	Lock Nut (Piston)	19	04-01-1095	Non-Pressure Housing
6	04-01-1030	Piston washer	20	04-01-1100	Return Spring
7	04-01-1035	Piston spring	21	02-01-1105	Push Rod
8	04-01-1040	O-Ring Upper Piston	22	04-01-1125	Heavy Duty Diaphragm
9	02-01-2100	Piston Assembly	23	04-01-1130	Pressure Housing
10	04-01-1050	O-Ring Lower Piston	24	04-02-1135	Pipe Plug 3/8"
11	04-01-1055	Cotter Pin	25	04-01-1140	Mounting Bolt
12	04-01-1060	Clevis yoke	26	04-01-1145	Carriage bolt, clamp ring
13	04-01-1065	Jam Nut-Clevis	na	02-01-2095	Brake O-Ring Kit
14	04-01-1070	Clevis pin	na	04-01-2085	Mini-Max Universal Boot



FRONT VIEW



TOP VIEW



BACK VIEW

NOTES:

(1) THREADED ROD LENGTH IS MEASURED FROM THE MOUNTING SURFACE TO THE END OF THE THREADED ROD.
(2) APPROXIMATE WEIGHT IS 13 LBS. INCLUDING MOUNTING HARDWARE.
(3) THE STANDARD BRAKE WILL BE DELIVERED WITH A CLEAR COVER CAP. THIS CAP SHOULD BE TAPED PRIOR TO PAINTING AND MUST BE REMOVED AFTER PAINTING.
(4) ALL BRAKES WILL BE SUPPLIED WITH ALL OF THE BREATHER HOLES PLUGGED. THE PLUG CLOSEST TO THE GROUNG SHOULD BE REMOVED AFTER MOUNTING.
(5) ALL BRAKES WILL BE SUPPLIED WITH A RUBBER BOOT.
(6) THE STANDARD PLATING IS ZINC DICHROMATE. IF EPOXY COATING IS DESIRED IT MUST BE SPECIFIED.
(7) DO NOT MOUNT THE BRAKE WITH THE COVER CAP FACING THE GROUND.
(8) ALL BRAKES ARE SUPPLIED IN THE RELEASED POSITION. THE BRAKES WILL AUTOMATICALLY APPLY WHEN AIR IS SUPPLIED TO THE SYSTEM.

I.T.I. INTERNATIONAL TRANSQUIP INC. P.O. BOX 590169 HOUSTON, TX. 77259	
ENGINEER: N.GOLDFEIN	DATE: 1/23/90
DRAWN BY:	
TITLE: STANDARD PRESSURE SEPERATOR BRAKE CHAMBER	
DRAWING NO. P/S-OEM-STD-005	

FIGURE 4

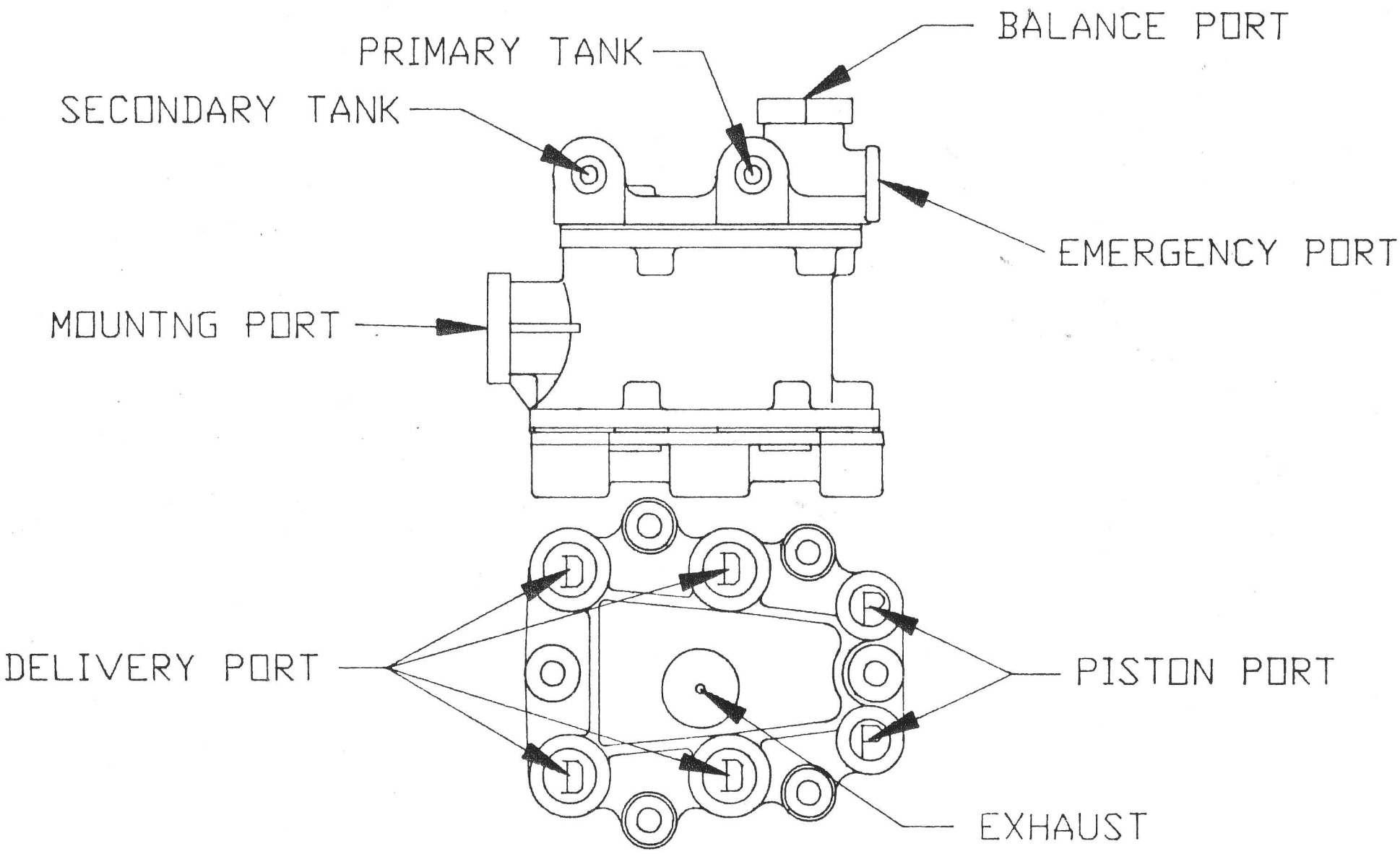

BALANCE PORT
PRIMARY TANK
SECONDARY TANK
EMERGENCY PORT
MOUNTNG PORT
DELIVERY PORT
PISTON PORT
EXHAUST

FIGURE 5

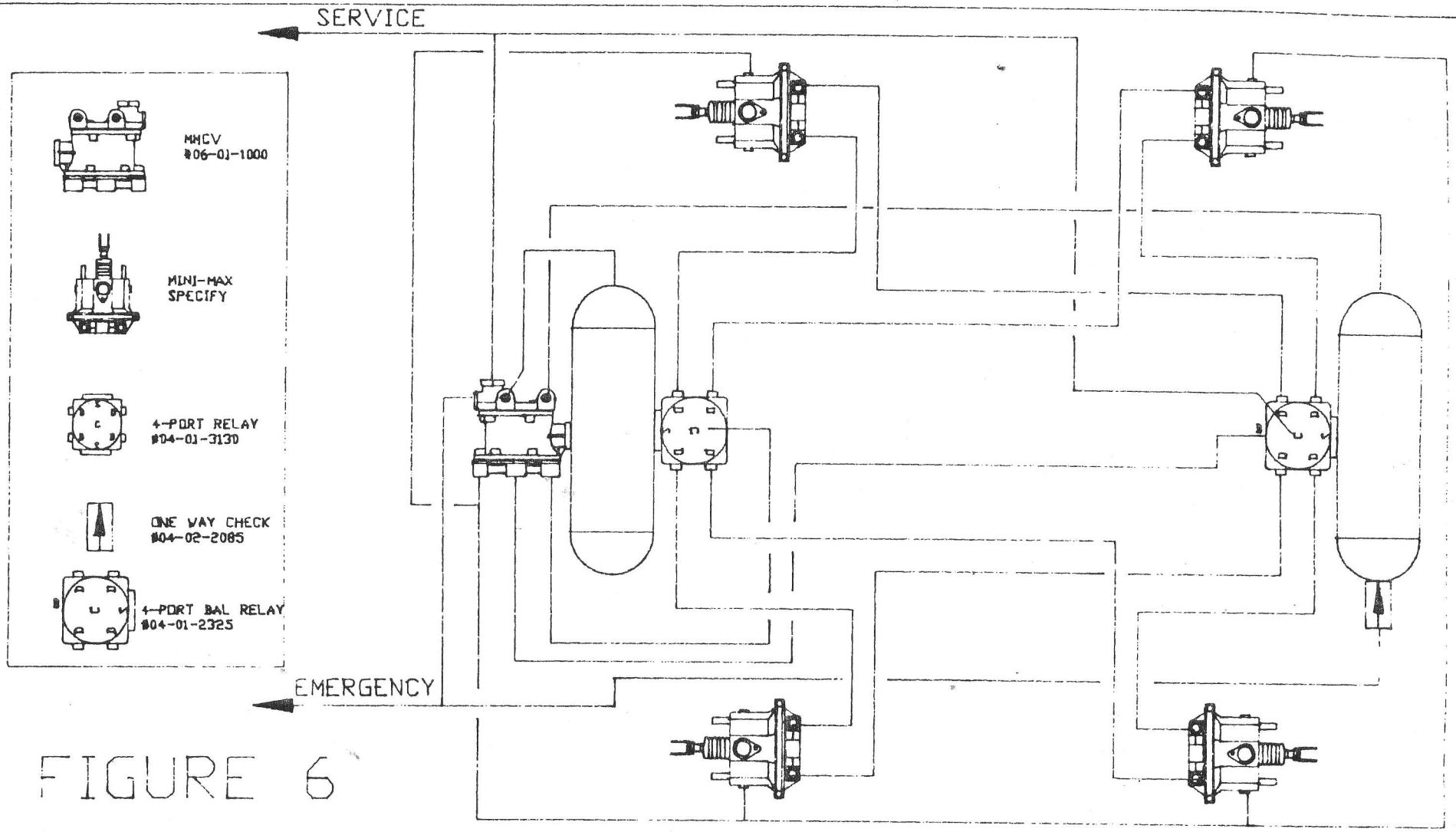


FIGURE 6

NOTES:

(1) EACH PISTON PORT IN MMCV SHOULD NOT RUN MORE THAN TWO MINI-MAX BRAKES

(2) MAKE SURE MANUAL RELEASE IS IN APPLIED POSITION

(3) MAKE SURE THAT ALL SYSTEM CHECK PROCEDURES ARE FOLLOWED EXACTLY WHEN CHECKING THE SYSTEM

(4) CHECK ALL INSTALLATIONS BEFORE RELEASING THE VEHICLE.

I.T.I. INTERNATIONAL TRANSQUIP INC.
P.O. BOX 590169 HOUSTON, TX. 77259

ENGINEER NGO DIEM	DATE 1/9/91
DRAWN BY	
TITLE: TANDEM AXLE TRAILER SYSTEM DS	
DRAWING NO. 2AX-TRL-DS-004	2AXTRLDS

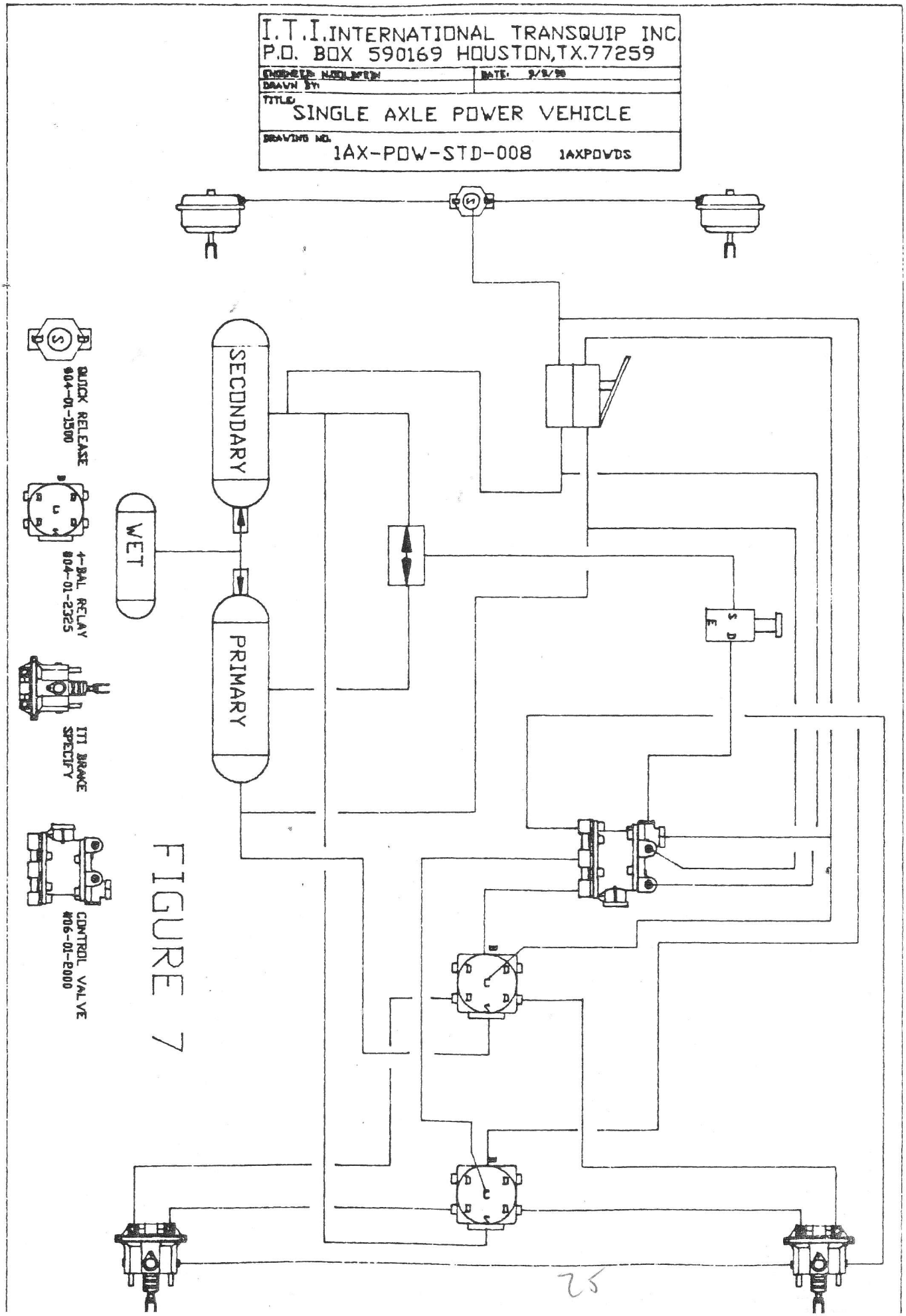

I.T.I. INTERNATIONAL TRANSQUIP INC.
P.O. BOX 590169 HOUSTON, TX. 77259
DRAWN BY:
DATE: 2/2/98
TITLE:
SINGLE AXLE POWER VEHICLE
DRAWING NO.
1AX-POW-STD-008 1AXPOWDS
SECONDARY
PRIMARY
WET
QUICK RELEASE
#04-01-1500
4-BAL RELAY
#04-01-2325
ITI BRAKE
SPECIFY
CONTROL VALVE
#06-01-2000

FIGURE 7

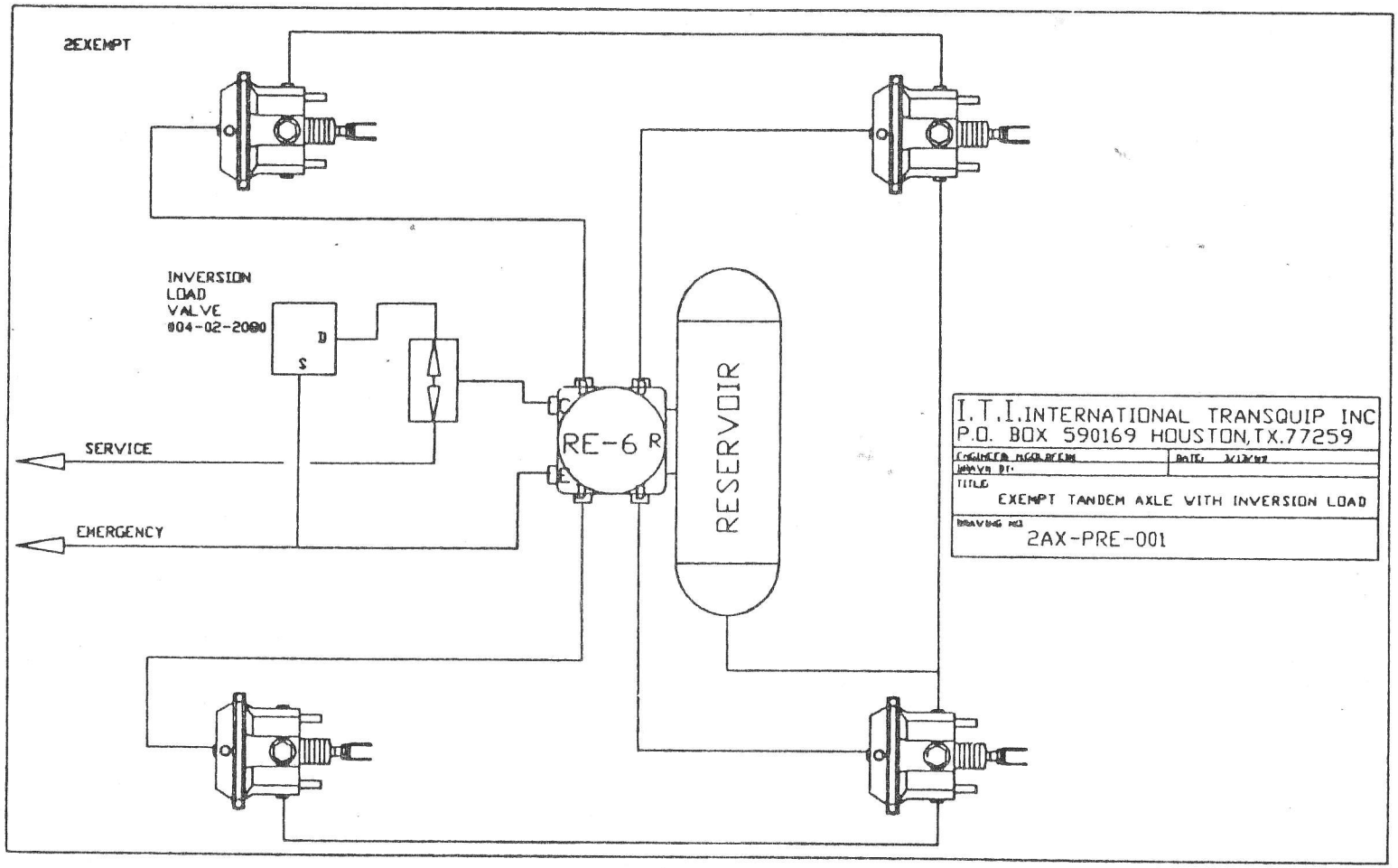


Figure 8. Alternative Trailer Diagram (Inversion Load)

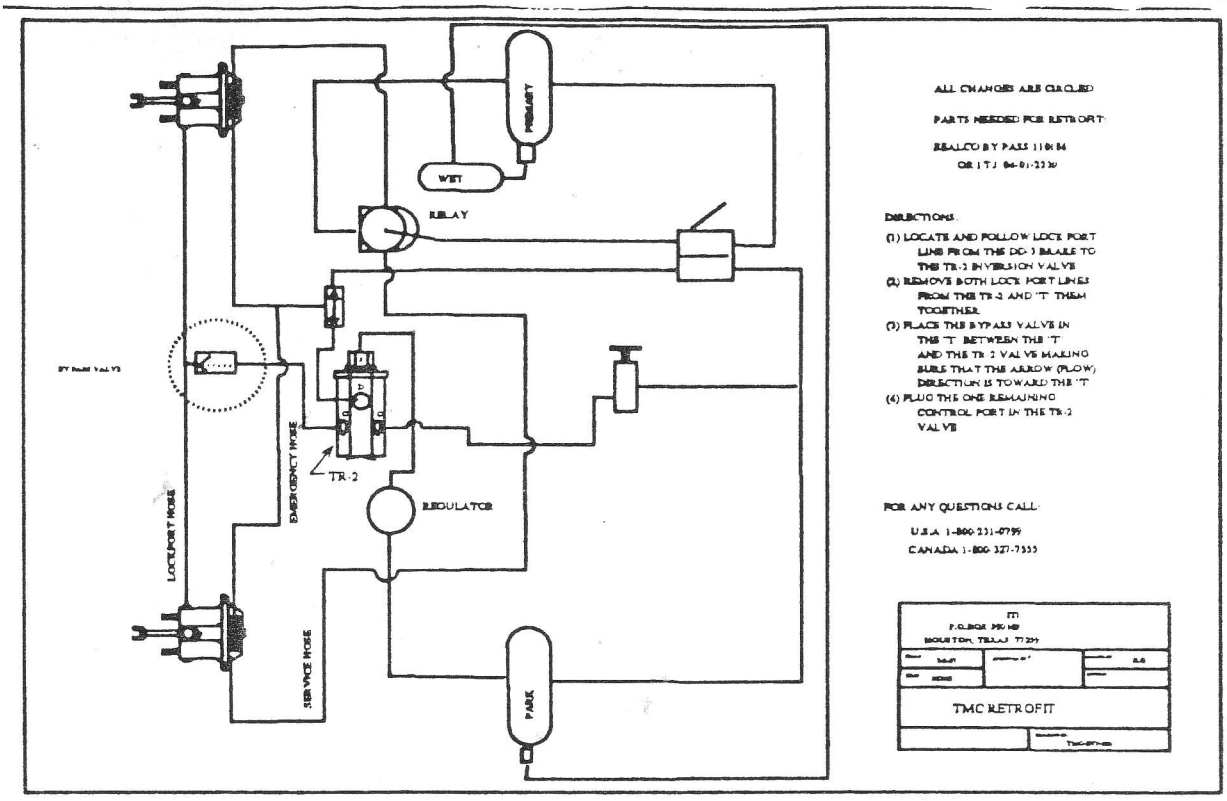


Figure 9. Bus Installation Diagram (TR2)

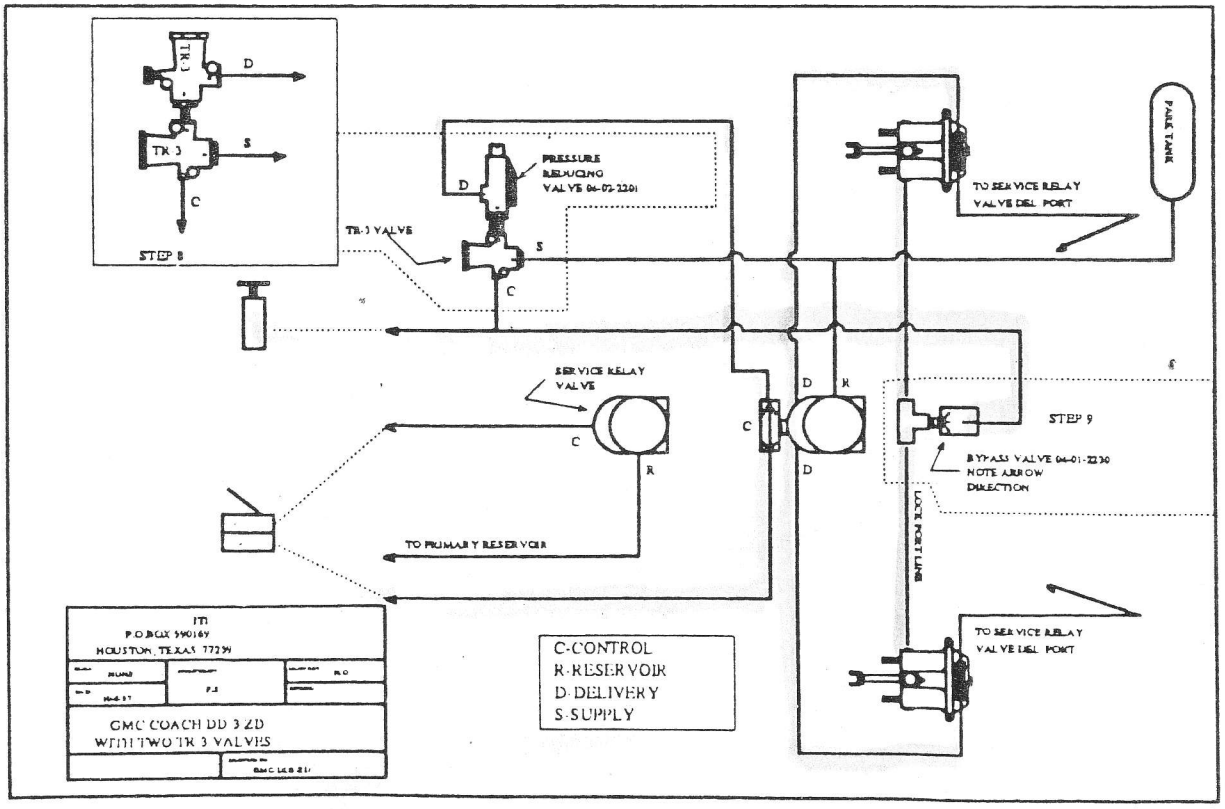


Figure 10. Bus Installation Diagram (TR3)

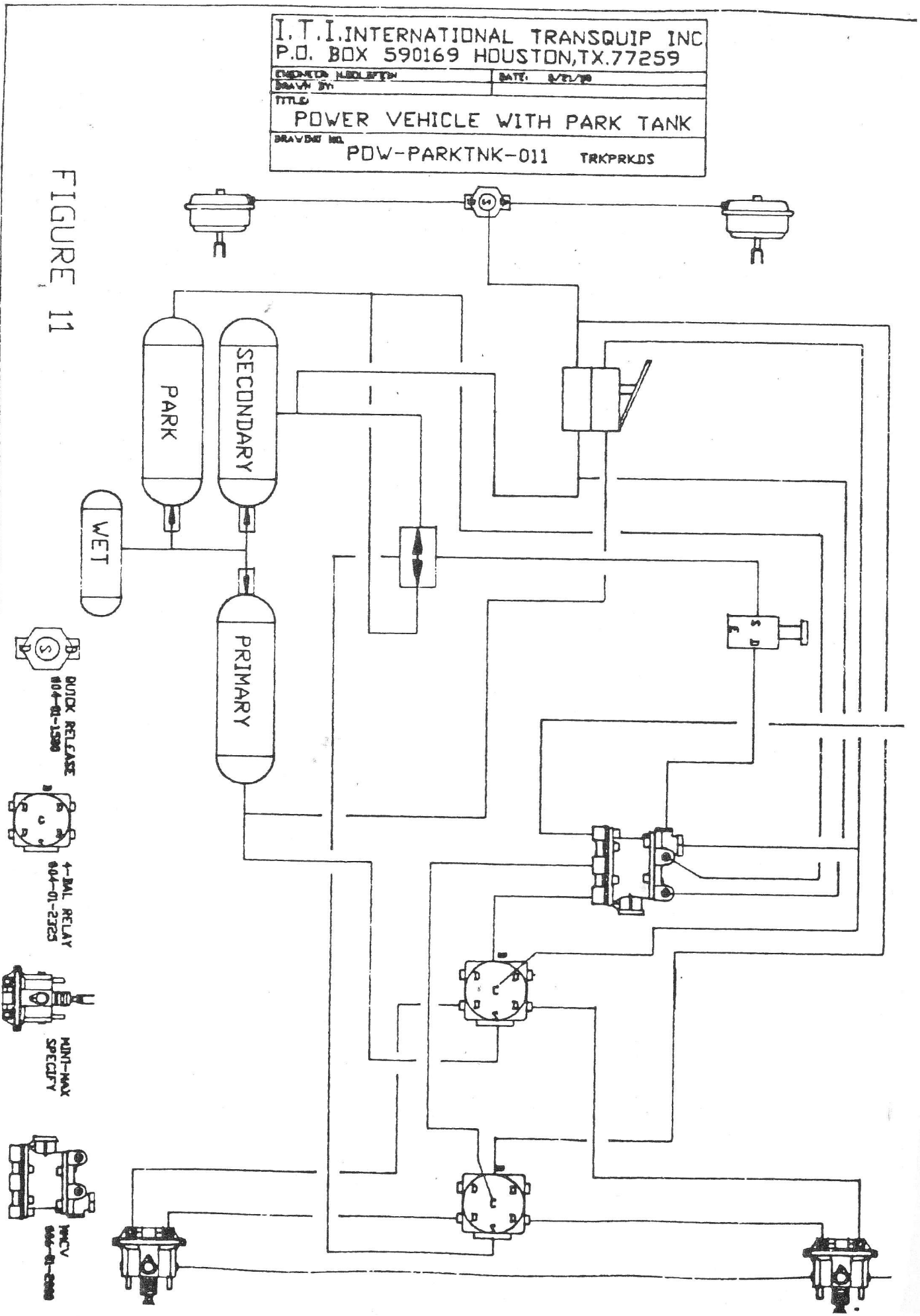

I.T.I. INTERNATIONAL TRANSQUIP INC
P.O. BOX 590169 HOUSTON, TX. 77259
TITLE:
POWER VEHICLE WITH PARK TANK
DRAWING NO.
PDW-PARKTNK-011 TRKPRKDS
PARK
SECONDARY
WET
PRIMARY
QUICK RELEASE
4-WAY RELAY
MINI-MAX SPECIFY
MACV

FIGURE 11